

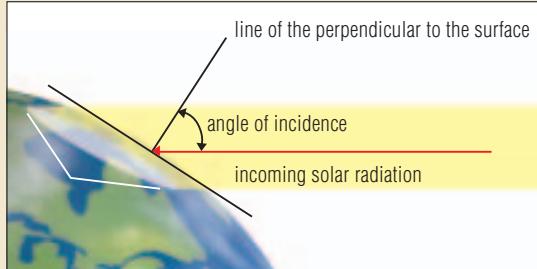
# Glossary

Note: The number in parentheses at the end of each definition indicates the page number in this book where the term first appears.

## A

- absorb** to convert radiant energy into another form of energy, such as kinetic energy (362)
- acceleration** change in velocity during a specific time interval (146)
- acid** substance that produces hydrogen ions ( $H^+$ ) when dissolved in water; compound that dissolves in water to form a solution with a pH lower than 7 (at 25°C) (62)
- active transport** movement of molecules or ions across a membrane against a concentration gradient; requires energy from ATP (278)
- adaptation** any change in the structure or function of an organism that makes it more suited to its environment (350)
- addiction** physical dependence on a drug (71)
- adenosine triphosphate (ATP)** nucleotide that releases stored energy in a cell (279)
- adhesion** tendency of unlike molecules to stick together (316)
- albedo** percent of incoming solar radiation that a surface reflects (363)
- alkali metals** soft, shiny, silvery elements, very reactive with water; group 1 in the periodic table (31)
- alkaline-earth metals** shiny, silvery metals, not as soft as the alkali metals; group 2 in the periodic table (31)
- altitude** the distance above Earth's surface, measured from sea level (the surface of Earth's oceans) (344)
- anecdotal evidence** evidence that relies on reports from people about particular events and their interpretation of these events; anecdotal evidence has not been tested for bias or to ensure it applies to general situations (352)

**angle of incidence** the angle between a ray falling on a surface and the line of the perpendicular to that surface (359)



**angle of inclination** the degree by which Earth's poles are tilted from the perpendicular of the plane of its orbit, or 23.5° (357)

**anion** negatively charged ion (35)

**area of elongation** an area of cells in the developing plant, facing away from the light source, that each elongate in a phototropic response to the light stimulus; the substance that initiates the phototropic response is auxin (326)

**arm of microscope** curved portion of the microscope that holds all the optical parts at a fixed distance and keeps them aligned (478)

**atmosphere** the layer of gases that surround Earth (343)

**atmospheric dust** solid particles less than 0.66 mm in diameter suspended in Earth's atmosphere (343)

**atmospheric pressure** the pressure exerted by the mass of air above any point on Earth's surface (372)

**atom** smallest part of an element that still has the properties of the element (21)

**atomic molar mass** average molar mass of an element's atoms, including those of all the element's different isotopes (34)

**atomic number** number of protons in an atom; can be used to specify an element (33)

**ATP** adenosine triphosphate, the nucleotide that releases stored energy in a cell (279)

**auxin** type of plant hormone that promotes cell growth or elongation (327)

**average speed** distance travelled in a specified time (128)

**Avogadro's number** number of atoms in 1 mol; approximately  $6.02 \times 10^{23}$ ; symbol:  $N_A$  (107)

B

**base** substance that produces hydroxide ions ( $\text{OH}^-$ ) in water; compound that dissolves in water to form a solution with a pH greater than 7 (at  $25^\circ\text{C}$ ) (62)

**base of microscope** bears the weight of all the parts of the microscope (478)

**bioindicator** an animal or plant that shows a measurable response to a change in its environment (332)

**biome** a large geographical region with a particular range of temperature and precipitation levels, and the plants and animals that are adapted to those climate conditions. (391)

**biosphere** a relatively thin layer of Earth that has conditions suitable for supporting life as we know it  
(343)

**bovine spongiform encephalopathy (BSE)** a chronic degenerative disease affecting the nervous system of cattle that is linked to specific infectious proteins called prions and produces large vacuoles or empty pockets in brain tissue; it is commonly known as “mad cow disease” (262)

**brightfield** illumination in the light microscope in which the specimen is illuminated by an unfiltered beam of white light that passes from the illumination source through the specimen, into the objective, and then to the eyepiece (253)

**buffer** substance that keeps the pH of a solution nearly constant despite the addition of a small amount of acid or base (62)

C

**calorimeter** a device used to determine the transfer of thermal energy (378)

**capillary action** the ability of the surface of a liquid to cling to the surface of a solid, causing the liquid to move along that solid (315)

**carbohydrate** sugars and related molecules formed by carbon, hydrogen, and oxygen atoms in a ratio of 1:2:1; used as a major energy source by organisms (271)

**carbon dioxide sequestering** a process of pumping carbon dioxide gas into the ground and storing it in sealed containers; may also refer to pumping carbon dioxide gas into the ocean bottom at very deep levels (424)

**carbon sink** any process that removes carbon dioxide from the atmosphere, such as photosynthesis (413)

**carbon source** any process that releases carbon dioxide to the atmosphere, such as burning of fossil fuels (413)

**carbonic acid** a weak acid produced by dissolving carbon dioxide in water (93)

**carrier protein** a protein present in a cell membrane that binds to a specific molecule and transports it through the membrane (278)

cation positively charged ion (34).

**cell communication** the ability of cells in a

multicellular organism to interact with each other and to influence each other's activity (262)

**cell membrane** structure that surrounds a cell and regulates the passage of materials between the cell and its environment; also called plasma membrane  
(267)

**cell theory** the cornerstone of biology, which states that all living things are made up of cells, the smallest units of life, and all cells are produced from pre-existing cells (251)

**cell transport** the movement of materials into and out of cells (274)

**cell wall** a rigid frame around the cell in plants, bacteria, and some protists; provides strength and support (268)

**cellular respiration** breakdown of glucose molecules to release chemical energy that a cell can use (82)



**centrioles** paired structures found in animal cells that are important for the process of cell division (272)

**channel protein** a protein in the cell membrane that forms a passageway through which specific solutes can pass by diffusion; some channels open and close in response to binding of specific molecules  
(278)

**chemical change** change to a substance that always results in the formation of a different substance or substances (18)

**chemical energy** potential energy stored in the chemical bonds of compounds (165)

**chemical equation** record of a chemical reaction using chemical symbols and formulas; shorthand way of showing the results of a chemical reaction (86)

**chemical properties** properties that describe the reactivity of a substance (13)

**chemical reaction** process that occurs when a substance or substances react to form a different substance or substances (15)

**chlorofluorocarbons (CFCs)** particular halocarbon compounds (70)

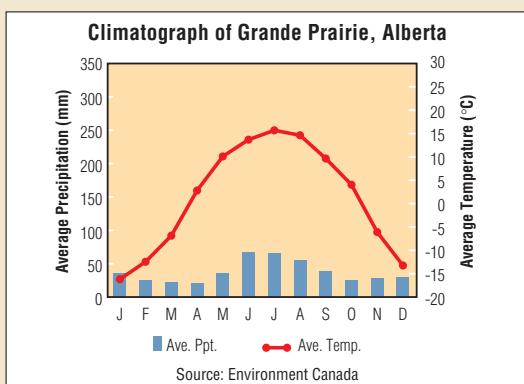
**chlorophyll** a green pigment that makes photosynthesis possible (272)

**chloroplast** a green organelle found in plants and some protists that contains chlorophyll and is the site of photosynthesis (268)

**climate** average weather conditions that occur in a region over a long period of time, usually a minimum of 30 years (342)

**climate change** change that occurs in the climate of a region over time, usually a minimum of 30 years (352)

**climatograph** a summary of the average temperature and precipitation for each month of the year for a given location, presented as a graph (403)



**closed system** any system that exchanges energy with its surroundings but does not exchange matter (199)

**coarse adjustment knob** moves the stage of the microscope up and down to bring the specimen into the focal plane of the objective lens (478)

**cogeneration** using waste energy from one process to power a second process (226)

**cohesion** tendency of molecules of the same kind to stick together (316)

**colloid** mechanical mixture in which the suspended substance cannot be easily separated from the other substances in the mixture (14)

**combustion** exothermic chemical reaction that occurs when oxygen reacts quickly with a substance to form a new substance or substances (81)

**companion cells** type of small phloem cells adjacent to sieve tube cells that appear to control sugar transport in the phloem (300)

**compound** chemical combination of two or more elements in a specific ratio (14)

**concentration gradient** difference within a given area between the highest and lowest concentration of a particular chemical substance (275)

**conclusion** the outcome of an experiment based on the agreement or disagreement of the data with the hypothesis (460)

**conduction** the transfer of thermal energy by direct contact between the particles of a substance, without moving the particles to a new location (370)

**confocal microscope** a microscope that uses confocal technology (257)

**confocal technology** systems that use the light microscope, laser beams, and computers to produce three-dimensional images from a combination of many perfectly-focused thin sections (257)

**contrast** the ability to see differences between structures due to differences in their capacity to absorb light (253)

**control systems** systems within plants that produce definite responses to specific stimuli (323)

**control** (in an experiment) part of the experiment in which the manipulated variable is not changed in any way from its normal condition (248)

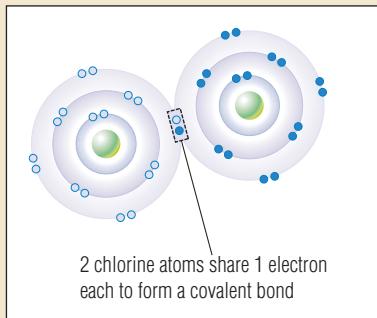
**controlled experiment** an experiment in which each variable is controlled in turn, allowing the experimenter to determine the effect of each (248)

**controlled variables** conditions that are held constant throughout an experiment (248)

**convection** the transfer of thermal energy by the movement of particles from one location to another (371)

**Coriolis effect** the deflection of any object from a straight line path, caused by the rotation of Earth (372)

**covalent bond** bond formed when non-metallic atoms share electrons; atoms in a molecule are bound together by covalent bonds (47)



**coverslip** thin piece of glass used to cover a specimen on a glass slide before examination under a microscope (480)

**crystal lattice** organized array of ions (40)

**current** flow from one place to another in one direction (371)

**cuticle** waxy, non-cellular, waterproof coating that covers a plant's leaves and stems (299)

**cytoplasm** a gel-like substance inside the cell membrane that contains nutrients and in which the organelles are suspended (267)

**cytoplasmic streaming** distribution of materials within cells through a circular flow of the cytoplasm (267)

**cytoskeleton** network of fine protein fibres that supports cells that contain a nucleus (272)

## D

**decomposition reaction** chemical reaction in which a compound breaks apart into its elements (94)

**density** mass per volume of a substance (371)

**dermal tissue** the outermost cell layer of plants; also called epidermis (309)

**desalination** the removal of salt from a solution, especially from seawater (288)

**dialysis tubing** a seamless cellulose membrane with pores of a specific size (295)

**diaphragm** adjusts the diameter of an opening to control the amount of light passing through the specimen (478)

**diatomic molecule** molecule composed of two atoms of the same element (48)

**diffusion** spontaneous movement of particles from an area of higher concentration to an area of lower concentration (275)

**displacement** vector quantity that measures the change in distance and the change in direction or position of an object (138)

**distance travelled** scalar quantity that measures how far an object has travelled (137)

**double replacement reaction** chemical reaction between two ionic compounds in solution that often results in the formation of at least one precipitate (100)

**ductile** description of a substance that can be drawn or stretched into long wires (29)

## E

**efficiency** ratio of the useful work output to the total work input; measurement of how effectively a machine converts energy input into useful energy output (216)

**elastic potential energy** energy stored in an object that has its shape changed by stretching, twisting, or compressing (175)

**electrical energy** work done by moving charges; energy produced by moving electrons (165)

**electrolyte** solution that conducts electricity; ionic compounds are excellent electrolytes (55)

**electron** negatively charged particle in the atom that occupies energy levels around the nucleus (22)

**electron microscope (EM)** a microscope that uses a beam of electrons to produce images of fine detail (258)

**scanning electron microscope (SEM)** an EM in which a three-dimensional image is formed by electrons bouncing off the surface of the specimen (259)

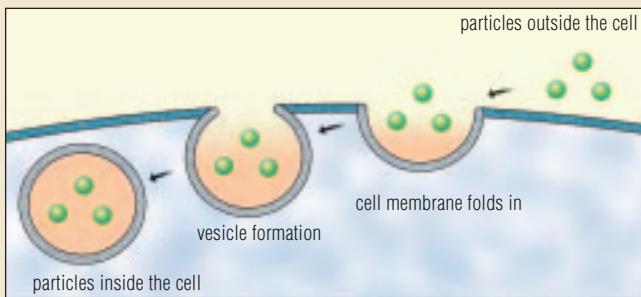
**transmission electron microscope (TEM)** an EM in which the image is formed by a beam of electrons that passes through a very thin section of a fixed and stained specimen (258)

**electron-dense** characteristic of a substance that does not allow electrons to pass through it, but either absorbs or scatters the electrons (258)

**element** pure substance that cannot be broken down into other substances; substance made up of only one type of atom (14)

**emission-reduction credits (ERCs)** credits given to a country under the Kyoto Protocol for actions that contribute to the global reduction of greenhouse gas emissions (422)

**endocytosis** uptake of particles or molecules by formation of a vesicle from the cell membrane; requires energy from ATP (281)



**endoplasmic reticulum (ER)** network of membrane tubes that branch from the nuclear envelope and circulate materials throughout the cell (268)

**smooth endoplasmic reticulum** ER lacking ribosomes (268)

**rough endoplasmic reticulum** ER studded with ribosomes (268)

**endothermic** energy absorbing (81)

**endothermic reaction** chemical reaction that absorbs energy (81)

**energy** ability to do work (160)

**energy input** energy used to do work (215)

**energy level** region of space near an atom's nucleus that may be empty or may contain electrons; electrons in energy levels nearest the nucleus have the lowest energy (32)

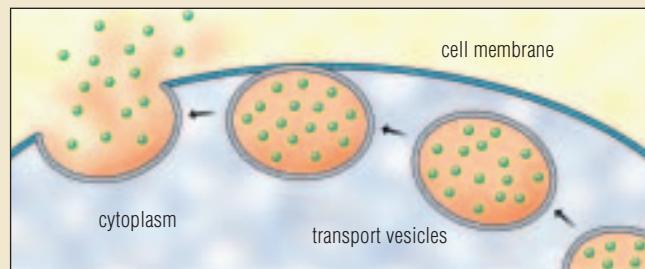
**enhanced greenhouse effect** the change in Earth's net radiation budget, caused by the increase in human-generated greenhouse gases (414)

**epidermis** the outermost cell layer of plants; also called dermal tissue (309)

**equilibrium** a state of balance between opposing actions (272)

**equinox** one of two points in Earth's orbit when the number of daylight hours is equal to the number of hours of night (359)

**exocytosis** release of molecules from a vesicle that fuses with the cell membrane to export the molecules from the cell; requires energy from ATP (281)



**exothermic** energy releasing (81)

**exothermic reaction** chemical reaction that releases energy, usually in the form of heat, light, or electricity (81)

**extrapolation** the process of estimating the value of a measurement beyond the known values of a set of data (412)

**eyepiece** magnifies the image from the objective lens and conveys it to your eye (478)

## F

**facilitated diffusion** diffusion of molecules across a membrane through binding to carrier proteins; does not require energy from ATP; *see also diffusion* (278)

**family** vertical column of elements in the periodic table; numbered from 1 to 18; also called group (31)

**fermentation** biochemical preservation technique involving bacteria (19)

**field of view** area that can be seen through the microscope with a given objective lens (245)

**fine adjustment knob** makes subtle adjustments to produce clear sharp images (478)

**first law of thermodynamics** the total energy, including heat, in a system and its surroundings remains constant (200)



**fluid-mosaic model** description of the arrangement of protein molecules in the fluid double layer of phospholipids that make up the cell membrane (272)

**fluids** substances with no definite shape (such as gases and liquids) (371)

**fluorescence microscopy** a technique to localize substances in cells by using the ability of those substances to fluoresce in the presence of ultraviolet light (256)

**force** push or pull applied to an object; measured in newtons (156)

**formation reaction** chemical reaction in which two elements combine to form a compound; also known as a synthesis reaction (91)

**formula equation** chemical equation that uses the chemical formulas of reactants and products in a chemical equation to represent a chemical reaction (40)

**formula unit** smallest amount of an ionic compound with the composition shown by the chemical formula; number of positive and negative ions in the smallest whole-number ratio that results in a neutral unit in the crystal lattice of a compound (40)

**fossil fuels** carbon-based fuels formed from the remains of living organisms (191)

## G

**gene mapping** a technique to locate the position of specific genes within the genetic make-up of an organism (261)

**general circulation model (GCM)** a climate model that incorporates the laws of physics to model climate on a global scale (419)

**geotropism** directional plant growth response to gravity; may be positive or negative; also called gravitropism (323)

**negative geotropism** growth against the gravitational force; also called negative gravitropism (323)

**positive geotropism** growth toward the gravitational force; also called positive gravitropism (323)

**GFP technology** a process that allows cell activities to be studied by attaching the green fluorescent protein (GFP) to particular parts of the cell (258)

**global warming** the observed increase in Earth's average temperature over time (415)

**Golgi apparatus** flat stack of membranes that receive, modify, and transport products of the endoplasmic reticulum throughout a cell (269)

**gravitational potential energy** energy of an object because of its position above the surface of Earth (167)

**gravitropism** directional plant growth response to gravity; may be positive or negative; also called geotropism (323)

**negative gravitropism** growth against the gravitational force; also called negative geotropism (323)

**positive gravitropism** growth toward the gravitational force; also called positive geotropism (323)

**greenhouse gases** gases that contribute to the greenhouse effect (365)

**ground tissue** parts of the plant body not included in the dermal or vascular tissue systems; function in storage, photosynthesis, and support (299)

**group** vertical column of elements in the periodic table; numbered from 1 to 18; also called family (31)

**guard cell** specialized epidermal cell that swells and contracts to control gas exchange through a stoma in a leaf (302)

## H

**halocarbons** human-made chemicals that can absorb large quantities of thermal energy (414)

**halogens** non-metals in group 17 in the periodic table; fluorine, chlorine, bromine, and iodine (31)

**heat** energy transferred from an object at a higher temperature to one at a lower temperature; thermal energy (169)

**heat engine** device that converts heat into mechanical energy (203)

**heat of condensation** the amount of energy released when 1 mol of a substance changes from the vapour phase to the liquid phase, without a change in temperature (383)

**heat of fusion ( $H_{\text{fus}}$ )** the amount of energy absorbed when 1 mol of a substance changes from solid phase to liquid phase, without a change in temperature (383)

**heat of solidification** the amount of energy released when 1 mol of a substance in the liquid phase changes to the solid phase, without a change in temperature (383)

**heat of vaporization ( $H_{\text{vap}}$ )** the amount of energy absorbed when 1 mol of a substance changes from vapour phase to gas phase, without a change in temperature (383)

**heat pump** device that uses mechanical energy to transfer heat (204)

**hemodialysis** treatment for kidney failure in which membranes in a dialysis machine clean the blood and remove wastes and excess water from the body that would normally be removed by a healthy kidney (287)

**herbaceous** describes a soft plant stem with little or no woody tissue (299)

**heterogeneous mixture** mixture in which the different substances are visible (14)

**homogeneous mixture** mixture in which the different substances are not visible (14)

**hormone** chemical compound that travels from its production site in an organism to other sites where it produces an effect (327)

**hydrocarbon** compound that contains hydrogen and carbon; common hydrocarbons include the main components of gasoline (a mixture of many liquid hydrocarbons) and many plastics (95)

**hydrochlorofluorocarbons (HCFCs)** compounds with similar properties to CFCs, but which destroy ozone much more slowly (421)

**hydrologic cycle (or water cycle)** the process by which water molecules move from Earth's surface into the atmosphere and then back again (382)

**hydrosphere** all the water on Earth, whether present as liquid, water vapour, or ice (343)

**hypertonic** describes a solution that has a higher solute concentration than another solution (278)

**hypothesis** a way of restating a cause-and-effect question so that it gives a reasonable possible answer; possible explanation for observations; proposed answer to a question being posed (51)

**hypotonic** describes a solution that has a lower solute concentration than another solution (278)

## I

**incoming radiation** all the radiant energy that reaches Earth (367)

**inert** unreactive with all but the most corrosive of acids (29)

**insolation** the amount of solar energy received by a region of Earth's surface (357)

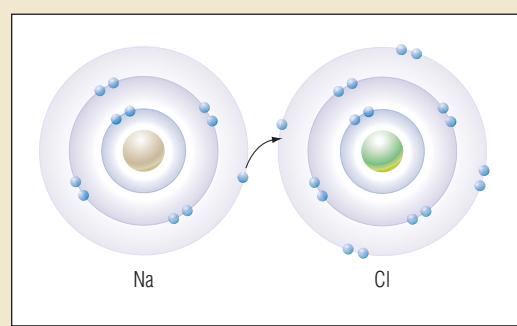
**insulin** hormone that binds to a protein on the cell membrane, allowing glucose to enter the cell by facilitated diffusion (286)

**Intergovernmental Panel on Climate Change (IPCC)** an international group of scientists who assess information on climate change (415)

**internal combustion engine** device in which energy is released by burning fuel inside the engine (210)

**ion** electrically charged atom or group of atoms (34)

**ionic bond** type of bond formed when electrons transfer between metals and non-metals (41)



One electron transfers from the sodium atom to the chlorine atom.

**ionization** process of an atom gaining or losing electrons (34)

**isolated system** system that cannot exchange either matter or energy with its surroundings (199)

**isotonic** describes a solution that has the same solute concentration as another solution (278)

**isotopes** atoms of the same element containing different numbers of neutrons (33)

## J

**jet stream** a band of fast-moving air in the stratosphere (374)

## K

**kinetic energy** energy of a moving object (167)

**Kyoto Protocol** an international agreement to reduce the emission of greenhouse gases (422)

## L

**lamp of microscope** supplies the light required to view the specimen (478)

**latitude** imaginary lines that run parallel to Earth's equator; the equator has a latitude of  $0^{\circ}$ , and the poles have a latitude of  $90^{\circ}$  N and  $90^{\circ}$  S (359)

**law of conservation of energy** energy cannot be created or destroyed; it can only be changed from one form to another, and the total amount of energy never changes (184)

**law of conservation of mass** total mass of the reactants in a chemical reaction equals the total mass of the products (21)

**lenticel** a raised spongy region in the stem of a woody plant that allows gas exchange between the atmosphere and the interior of the plant (313)

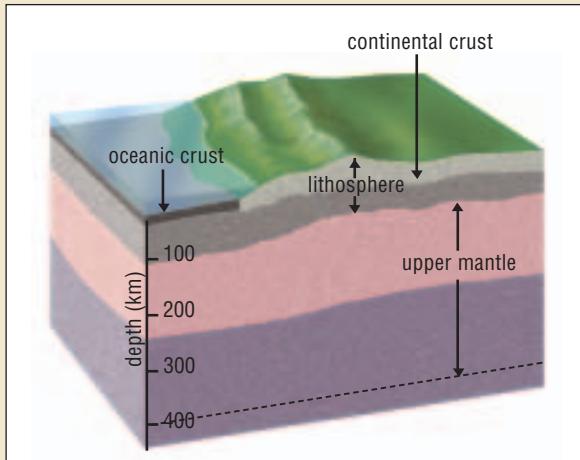
**life force** a natural force postulated to produce life spontaneously (spontaneous generation); the theory of a life force was disproved by Pasteur (247)

**light microscope** an instrument with a system of lenses used for magnification in which the specimen is illuminated by a beam of white light (244)

**lipid** fats and oils formed of carbon, hydrogen, and oxygen atoms in a ratio different from 1:2:1; insoluble in water (271)

**liposomes** fluid-filled sacs surrounded by a phospholipid bilayer identical to the cell membrane of human cells; they can be incorporated into living cells, and are used to transport medication into diseased cells without affecting normal cells, and to insert DNA in gene therapy (285)

**lithosphere** solid portion of Earth, composed of rocks, minerals, and elements (343)



**lysosome** organelle containing enzymes that digest food, destroy bacteria, or break down damaged organelles in cells containing a nucleus (269)

## M

**magnification** an increase in the apparent size of an object, calculated as the product of the magnifying powers of the objective lens and the eyepiece (244)

**malleable** description of a substance that can be beaten or rolled into sheets without crumbling (29)

**manipulated variable** condition deliberately changed in an experiment (65)

**mass number** integer equal to the total number of protons and neutrons in the nucleus of an atom (33)

**Material Safety Data Sheet (MSDS)** information sheet on a hazardous product used in workplaces, including schools; identifies the chemical and physical hazards associated with the product (9)